DEPARTMENT OF AGRICULTURE.

BULLETIN No. 13.

REPORT OF

PROF. C. B. COCHRAN,
CHEMIST, WEST CHESTER, PA.,

RELATING TO

BUTTER COLORS.

LEVI WELLS,
DAIRY AND FOOD COMMISSIONER, HARRISBURG, PA.

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Commonwealth of Pennsylvania,
Department of Agriculture,
Harrisburg, Pa., August 22, 1896.

Hon. Thos. J. Edge, Secretary of Agriculture:

Dear Sir: I herewith transmit the analyses by Prof. Cochran of several leading butter colors in our State; also the results of a series of experiments conducted by the Professor relating to the toxic properties of aniline colors of which some of these preparations are composed.

Many dairymen have been misled as to the nature of one, at least, of these aniline colors, supposing it to be a vegetable preparation, as it is so advertised on the label. Selling these goods under a false label is clearly a violation of clause four, section three, of the pure food law of this State.

Very respectfully yours,
LEVI WELLS,
Dairy and Food Commissioner.

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West Chester, Pa., August 19, 1896.

Major Levi Wells, State Dairy and Food Commissioner, Harrisburg, Pa.:

Dear Sir: I respectfully submit the following brief report of work done on some of the common butter colors found in the markets of our State.

The following butter colors have been examined:

	Name of butter color.	Coloring matter found.
1st.	Hansen's Columbian,	Coal Tar Color.
2.	Wells, Richardson & Co.'s Improved,	Coal Tar Color.
3d.	Perry's Concentrated,	Coal Tar Color.
4th.	Hansen's Danish,	Annatto.
5th.	Thatcher's Orange,	Annatto.
6th.	Annattoine,	Annatto.

The first five samples were solutions of the coloring matter in oil. The sixth was a finely divided powder, which on burning yielded a large amount of ash, and when examined microscopically, showed many granules of annatto starch. No attempt was made to do more than find the principal coloring matter in each sample. Other coloring substances may have been present in smaller amounts. Sometimes two or more coloring substances are found in the same sample. For example, of two butter colors previously examined, one contained annatto and turmeric, the other carrot color and turmeric.

The coal tar colors found in the three samples given above were two in number, both of which seemed to belong to the amido-azobenzene class. Two gave reactions for aniline yellow, the other for butter yellow, a coloring matter closely resembling methyl orange.

Annatto is a vegetable color derived from the fruit of bixa orellana, a plant native to the West Indies and Northern South America. It is said to be prepared for the market principally in Brazil and Cayenne. In his "Commercial Organic Analysis," Vol. II, page 352, Allen makes the following statement: "Cayenne Annatto is a soft paste of a bright yellow color. It often has a repulsive, urinous odor, said to be due to the actual addition of urine to keep it moist and impart a richer color." The samples of annatto which have come under my observation have had a pasty or putty-like consistency, a dull red color, and have been free from any marked disagreeable odor.

The most important use for annatto is in coloring butter and cheese. It is generally regarded as free from any poisonous properties, and my own somewhat limited experiments give conclusions in harmony with this general opinion. Several years ago I had occasion to testify to the harmless qualities of a certain butter color,

which on examination I found to be a preparation of annatto in oil. I then took a teaspoonful of this butter color, an amount sufficient to have colored twenty pounds of butter. Similar experiments have been made on commercial annatto. No injurious effects resulted.

The coal tar colors are exceedingly numerous. They are numbered by the thousands, and include the greatest variety of colors and tints. Their solutions present most beautiful shades of violet, blue, green, yellow and red. In fact, a novice would hardly realize that so great a variety of colors was possible. Physics teaches us that musical tones are analogous to color; the first interpreted through the ear; the second, through the eye. Just as it is possible to have an almost infinite variety of tones differing in one or more respects, so also it is possible to have a remarkably great variety of colors. Perhaps the time may not be far distant when color training will be a part of our system of aesthetic education, just as musical training now is.

Comparatively speaking, only a few of the vast number of known coal tar colors are of commercial importance. Allen, in his "Commercial Organic Analysis," Vol. III, Part I, describes between one hundred and fifty and two hundred. The coloring matters prepared from coal tar products are used for all kinds of dyeing and coloring purposes, and, consequently, have largely displaced the vegetable coloring substances. Among other uses to which they are applied is the coloring of foods, confections, wines and liquors.

Although the majority of coal tar colors are, from a sanitary standpoint, comparatively harmless substances, a few of them are decidedly poisonous. The most careful study of the effects of coal tar colors upon the animal organism, of which I have any knowledge, is found in a little book entitled "The Sanitary Relations of the Coal Tar Colors," by Theodore Weyl, translated by Dr. Henry Leffmann. In this book are described seven coal tar colors possessing marked poisonous properties. Of these, five are yellow or orange, and two are green. The names of these poisonous coal tar colors are: 1st, Martin's Yellow, known also as Naphthalene Yellow and Manchester Yellow; 2d, Dinitrocresol, or Saffron Substitute; 3d, Picric Acid; 4th, Metanil Yellow; 5th, Orange II, or Beta Naphthol Orange. To these may be added Aurantia which is classed as suspicious. The two green poisonous colors are 1st, Dinitroso-resorcinol, and 2d, Naphthol Green B.

Neither of the coal tar dyes found in the list of butter colors analyzed are described to any extent in this book, and the various chemical works treating of the coal tar dyes, to which I have ready access, furnish little information from a sanitary standpoint. Consequently, I undertook a few experiments for the purpose of more definitely settling the question, in my own mind at least.

Exp. I. On Saturday, August 8, 1896, I took twenty-five drops,

very nearly half a teaspoonful, of Perry's Concentrated Butter Color. On the same day, my assistant, Mr. C. S. Brinton, took twenty drops of the same butter color. The quantity of coloring matter taken by each of us was sufficient to color from five to ten pounds of butter. Neither of us felt any ill effects from the dose.

Exp. II. On Monday, August 10, Mr. Brinton, took forty-two drops of the same butter color. No effects were felt. The quantity taken at this dose would color enough butter to last an average consumer about two months.

Exp. III. On Wednesday, August 12, I took sixteen drops of Wells, Richardson & Co.'s Improved Butter Color, and Mr. Brinton took thirty-two drops. No decided effects resulted to either of us, but Mr. Brinton felt slight cerebral and stomach disturbance.

Exp.. IV. At 10 a. m., on the following day, we gave a chicken, weighing 400 grams (14 ounces), a teaspoonful of the last named butter color, and at 3 p. m. a second teaspoonful was administered. The chicken showed no evidence of poisoning, although when compared to the weight of the chicken the quantity taken was immense, one-sixtieth of the weight of the fowl. The coloring matter soon appeared in great abundance in the excreta.

Exp. V. On Friday, August 14, at 2 p. m., this chicken was given one-fourth gram, or four grains, of Aniline Yellow, Amido-azo-benzene. No symptoms of poisoning were manifested.

Exp. VI. On Saturday, at 10 a. m., the same chicken was given four grains of Methyl Orange. No direct effects of this dose were noticeable. In these three days the chicken had been most heavily dosed with the coal tar colors found in butter colors. The quantity taken would probably be sufficient to color more than one hundred pounds of butter. For forty-eight hours after concluding these experiments the chicken appeared rather stupid and did not seem ready to eat. At this time further observations were prevented as the chickens mysteriously disappeared during the night. This accident, due to my own carelessness in not protecting the fowl, was unfortunate since it prevented me from gaining any information concerning the final effect of the enormous doses of coal tar colors.

Exp. VII. On Friday afternoon, August 14, at 4 p. m., I took two grains of Aniline Yellow, Amido-azo-benzene. No unpleasant symptoms resulted. The color of the urine excreted that evening was orange yellow, deeper than normal, and dyed silk-brilliant yellow. The urine passed on rising in the morning was similar to that passed the preceding evening. At 10 a. m. the urine was of normal color and no longer dyed silk. None of the coloring matter was present in the intestinal discharges.

From this experiment it would seem that the coloring matter is entirely absorbed and then rapidly excreted by the kidneys. In

eighteen hours after taking, the two grains of Aniline Yellow were almost, if not entirely, excreted.

Exp. VIII. On Saturday, at 10.30 a. m., Mr. Brinton took two grains of Methyl Orange, from which he experienced no uneasiness. The color of the urine excreted four hours later was orange yellow, and gave reactions for Methyl Orange.

Exp. IX. On Saturday, at 9 a. m., a young woman took one teaspoonful of Wells, Richardson & Co.'s Butter Color. Three hours later severe headache, nausea and vomiting occurred, followed by considerable nervous depression, which kept her confined to her bed until Monday evening. During all this time the nausea and headache continued, but with gradual abatement. The urine was orange-colored and dyed silk bright yellow, the same as the Aniline Yellow did in experiment VII.

Judging from my previous experiments, I did not anticipate such a result as followed in this case and, consequently, felt inclined to regard the sickness as a mere coincidence rather than the direct result of the dose of butter color.

A few days after this occurrence I was informed by Dr. John A. Miller, of Niagara University, Buffalo, N. Y., that he gave to a dog weighing about 25 pounds a teaspoonful of Wells, Richardson & Co.'s Improved Butter Color, and that this dose produced nausea and vomiting, and increased the rate of the heart's action. In a few hours the animal recovered. On the following day he administered one-half teaspoonful of this butter color to the same dog. The pulse became more rapid and for a time there were symptoms of nausea, but no vomiting.

Exp. IX. In order to make more certain of the effects of this coloring agent, Mr. Brinton and myself each took, at 9.30 a. m., twelve drops of W. R. & Co.'s Improved Butter Color. At 10.40 a. m., we each took an additional twelve drops, and at 11.40 a. m., a further dose of twelve drops, making in all thirty-six drops taken by each of us in a little over two hours.

At noon Mr. Brinton complained of feeling dull, but ate a hearty dinner. During the afternoon, he had a headache, some nausea and vomiting. At noon I felt slight nausea, had some headache and no desire for food. At 4 p. m., we had both recovered, with the exception of slight headache. During these experiments, the pulse was carefully watched, but no increase in rate was observed. At 12.30 p. m., the renal excretion of each of us contained enough of the coloring matter to dye silk bright yellow, while that passed at 4 p. m. was orange color and rapidly dyed silk.

While it is true that the quantity taken in these experiments is very great when compared with that obtained by eating butter, yet they show that the coloring matter is not in itself entirely harmless. Decided physiological effects seem to follow the administration of

comparatively small doses. Whether the continued use, even in exceedingly minute quantities, of a substance capable of producting the effects described is, in all cases, free from objection may, perhaps, be questioned.

The sample received from Major Wells, which was marked Hansen's Columbian, seemed to contain the same coloring matter as W., R. & Co.'s Improved Butter Color. The physical and chemical tests applied to these two butter colors gave identical results. The physiological action of the two also seemed to be similar.

Exp. X. At 10 a. m., September 7, Mr. Brinton and myself each took twelve drops of Hansen's Columbian Butter Color (sample from Major Wells). One hour later, we each took an additional dose of twelve drops. Slight headache and considerable stomach disturbance attended with nausea and vomiting followed in a few hours in each case.

Headache, loss of appetite, nausea, vomiting and nervous depression seem to us to be the effects produced by the administration of comparatively large doses of these butter colors, the intensity of these symptoms varying according to amount taken.

It seems that some of the coal tar colors used in coloring butter are manufactured under private contract especially for the makers of butter color. Consequently, they are not to be found on the market, and can only be obtained mixed with oil as they exist in the prepared butter colors. This fact is especially interesting from the standpoint of a chemist, because of the difficulty he encounters in obtaining samples of the same coloring substance.

The coal tar colors, as has been stated, are very extensively used in coloring foods, confections, liquors, and soft drinks. The attempt to please the eye by this method is, perhaps, carried too far in this country. In many cases it is a means of concealing inferiority. There seems to be very little evidence that the majority of the coal tar colors thus used are injurious to health. It is, however, a question whether the too extensive and almost reckless coloring of various articles destined to enter the human stomach, even if the coloring matter used is not poisonous, should receive encouragement. The subject of coloring food has been kept under careful legal control in every country and state, so far as I know, where any special legislation in regard to food exists. In most cases, however, all that is attempted is to prohibit the use of those coloring matters known to be injurious to health. New coloring matters are continually appearing in the markets of the world. In order to prevent manufacturers from experimenting upon the public, the use of such substances should be prohibited, until their influence upon the human organism has been investigated.

C. B. COCHRAN.